



# United States Department of the Interior

## GEOLOGICAL SURVEY

### RESEARCH CRUISE REPORT

Ship Name: R/V KANA KEOKI

Operating Institution:  
Univ. of Hawaii

Cruise No.: BLM-Leg Charlie

Dates: 11/29/74 - 12/21/74

Area of Operation: South Texas Outer Continental Shelf extending from Matagorda Peninsula southward to the U.S./Mexico International Boundary

Port Calls: 1) - Galveston, Nov. 29-30. Fueling stop at request of Univ. of Hawaii to take on 60,000 gals. of diesel fuel supplied by the U.S. Navy. Contract not charged for the two days required for trip to Galveston.

2) - Brief stops necessitated by equipment malfunction:

Port Isabel - to pick up replacement antennae for the Decca Hi-Fix navigation system

Port Aransas - to repair power bank for minisparker system

Project Title: Marine geological survey, Texas Outer Continental Shelf as a part of the BLM Baseline Environmental Assessment Program

Chief Scientist: Henry L. Berryhill, Jr.

#### Scientific Crew (USGS)

1. Henry L. Berryhill, Jr., Geologist and Chief Scientist
2. Ronald Miller, Physical Science Technician (Biology)
3. Jean Freeland, Physical Science Technician (Geology)
4. Richard Phillips, Geologic Field Assistant
5. Deborah Hutchinson, Geologic Field Assistant
6. Patricia Forrestel, Geologic Field Assistant
7. Charles Meeter, Geologic Field Assistant
8. Robert Fitchko, Geologic Field Assistant
9. Elizabeth Hovey, Geologic Field Assistant
10. Donald McNair, ET, side scan sonar, Ocean Systems, Inc.
11. Robert Cole, Regional Supervisor, Decca Co.
12. Robert Trice, Navigator, Decca Co.
13. Roger Melton, Navigator, Decca Co.

Description of Scientific Program: The over-all program is a baseline assessment of the South Texas Outer Continental Shelf, a program funded by the Bureau of Land Management, Department of the Interior. Objectives of the geological studies being carried out under the program by the Geological Survey are: nature and distribution of bottom sediments, nature of suspended sediments in the water column, trace metals chemistry of sediments; late Pleistocene and Holocene structural and sedimentologic evolution of the shelf; delineation of surface areas of the shelf where geologic conditions might be hazardous to petroleum development; and predictive evaluation to the extent possible of the possible effects of the physical and chemical processes operative across the shelf on the dispersion and assimilation of contaminants that might be generated by petroleum development.

Work Completed:

- A. Station Work. - 61 bottom stations occupied during leg. The following station work by category of sampling technique was accomplished.
1. Smith-MacIntyre grab - 40 (6 subsamples at each station)
  2. Gravity (pipe) cores - 13
  3. Box cores - 32
  4. Benthic faunal collections - hopper sieving through 500  $\mu$  mesh of all grab and box cores - 72
  5. XBT records - 12
  6. Surface drifter casts (3 at a station) - 12 stations
  7. Quality control sample for trace metals - 6
  8. Hydrocarbon back-up sample - 32
  9. Water samples for suspended sediments - 9 (3 at each of 3 stations)

All station work for geologic studies now completed.

B. Continuous Survey - geophysics:

- I. Minisparker (800-900 Joules) seismic reflection profiles - approx. 1000 miles.
  - a. General geographic areas of coverage:
    - 1). Continuous traverse along strike, inner shelf;
    - 2). Continuous traverse along strike, outer edge of shelf;
    - 3). Seven traverses normal to strike across entire shelf - Rio Grande Delta;
    - 4). Three traverses normal to strike across the entire northern part of the study area and a number of partial profiles normal to strike of varying length and on various parts of the shelf.
    - 5). Traverse along mid-shelf, parallel to strike;
    - 6). Crossings of all major topographic highs along the outer shelf; several crossings over some; and tie traverses connecting all major highs.

- II. 3.5 kHz profiles - Approx. 1,400 miles (run simultaneous with minisparker plus station to station during bottom sampling and on runs to navigation system calibration points).
- III. 12 kHz PDR - During all survey work for first two weeks of leg - malfunctioned and could not be repaired at sea.
- IV. Side scan sonar (Klein, Model 400) - Approximately 400 miles run simultaneously with acoustical profiling, concentrated over the belt of reefs or topographic highs near the edge of the continental shelf. All major reefs were covered in at least one direction and most in two or more directions. Recording scale was alternated, depending on the situation, between 150 and 300 m, total scanning width.

Summary of Sea State and Operational Problems:

A. Sea State

Average wave and swell conditions for the over-all work period was 4-5 ft; conditions ranged from those generated by a prolonged gale accompanying a frontal system passage early in the work period that brought sustained winds of 35 kts. gusting to 55 kts. and 16-18 ft. waves, to a very calm period of three days at the end of the work period. Total down time because of sea state and weather was 16 hours.

B. Operational Problems

The Decca Hi-Fix system continued to be inoperative during most of the night hours throughout much of the work period. In addition, two days of daylight Hi-Fix navigation time were lost because of equipment malfunction: a defective receiving antennae on one occasion and a dead transmitting tower at the Brownsville station on another. The defective antennae necessitated a port call at Port Isabel to pick up a replacement. Lack of night operation at the Hi-Fix system was attributed by Decca to sky wave problems which they say are worst during the winter months when atmospheric temperatures are colder. Total down time for the Hi-Fix system during the survey period was 40 percent. During Hi-Fix down time navigation was accomplished by simultaneous use of three methods: satellite; Loran A and use of the Hi-Fix when Decca could ascertain that signals could be followed to within two to three lane counts and thus capable of being post-plotted on the basis of periodic ties into a calibration station during daytime when signals were good. The latter use of the Hi-Fix did not result in the accuracy to 15 ft. but within the range of 100-200 ft. This accuracy was deemed adequate by the Chief Scientist for much of the long-continuous geophysical profiles.

### Principal Preliminary Scientific Observations:

1. Patterns on the acoustic profiles that are believed to be gas seeps were recorded at a number of places on the shelf. These are most numerous on the outer edge of the shelf where they are associated with faults, around and over the major reefs (topo. highs) and over parts of the Rio Grande Delta. Acoustical shadow areas on the minisparker records in the upper 1000 ft. of strata suggest gaseous sediments at a number of places.
2. Extensive faulting over most parts of the South Texas OCS. These are principally down to the basin growth faults which are most numerous on the outer part of the shelf and faults over domal (diapiric) structures. Only a few of the faults extend to the sea floor, but a large percentage cut the uppermost Pleistocene sequence and, therefore, lie at only shallow depth.
3. The submerged reefs, or so-called topographic highs, are but the exposed part of extensive thin carbonate "banks" that have been buried during Holocene sedimentation. These underlie extensive parts of the middle shelf and appear to consist in part of smaller buried reef mounds and beds of shell and reef debris that accumulated in shallow water during the period of reef growth. In a few places the carbonate layer associated with the reefs has been cut by faults. A very quick comparison of the acoustical profiles indicates that the Hospital-Aransas-Baker reef groups have a smoother upper surface than those further south which have a more jagged appearance characterized by numerous "pinnacles" rising several meters above the main reef surface.
4. Almost without exception, the major reefs are surrounded by moat-like depressions formed by a decrease in the Holocene shelf sediment sequence as the reef is approached. The nature of these "moats" suggests sediment removal by current action in the same fashion as loose sediment is removed from cobbles in a stream bed. The occurrence of manganese nodules on the fringes of several of the reefs further supports non deposition on and around the reefs. This precursory inference is subject to revision upon further scrutiny, but ubiquitous strong current movement along the outer shelf floor is strongly suggested.
5. The Rio Grande Delta appears to be a very young geologic feature. The thickness of Holocene sediments over large areas of the submerged delta is only a few inches and live coral was recovered in several samples from the delta surface.
6. The thickness of Holocene shelf transgressive sediments over the middle and outer shelf have been under-estimated in past reports on the area, e.g. (Shepard et al, 1951) which gave thickness in

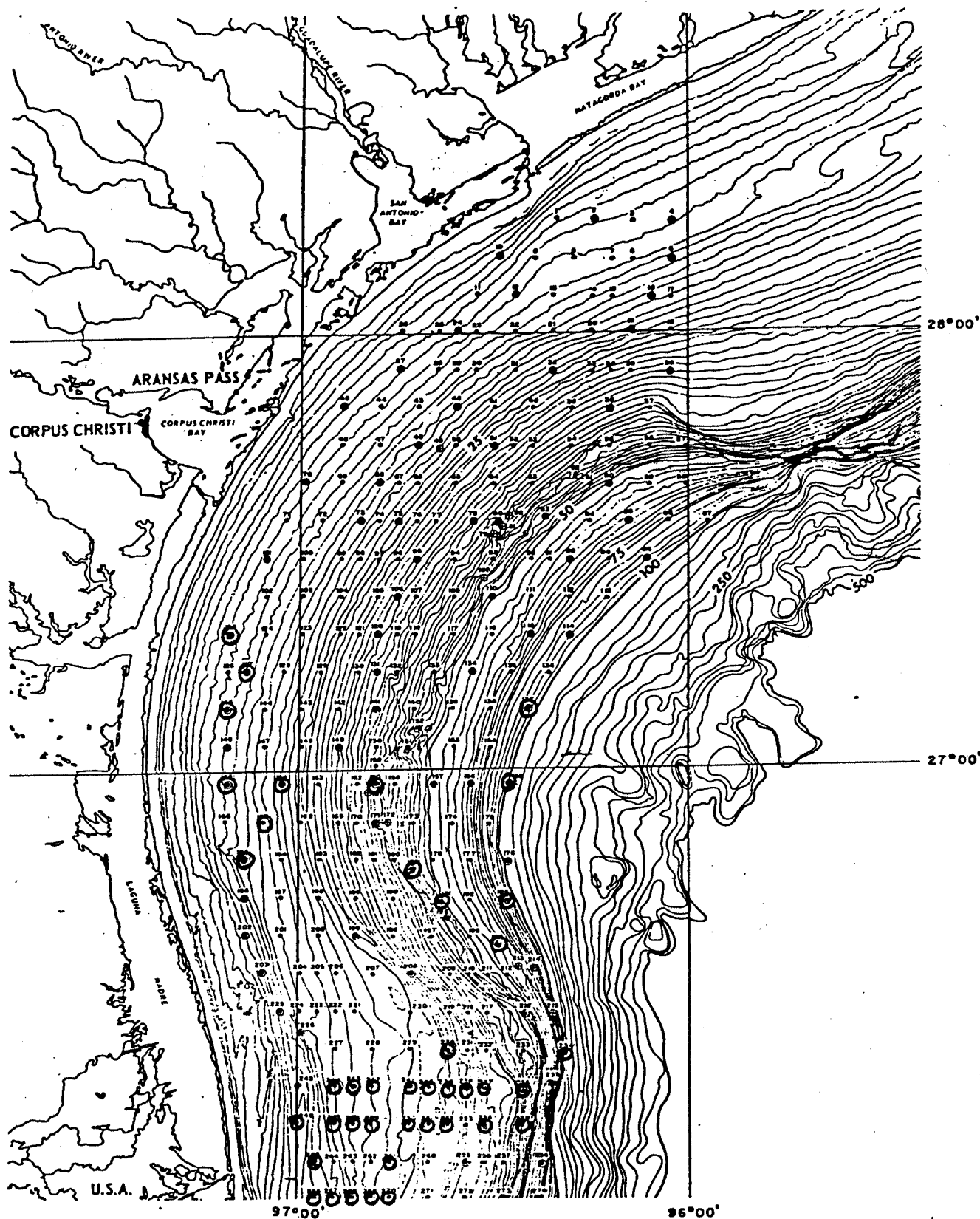
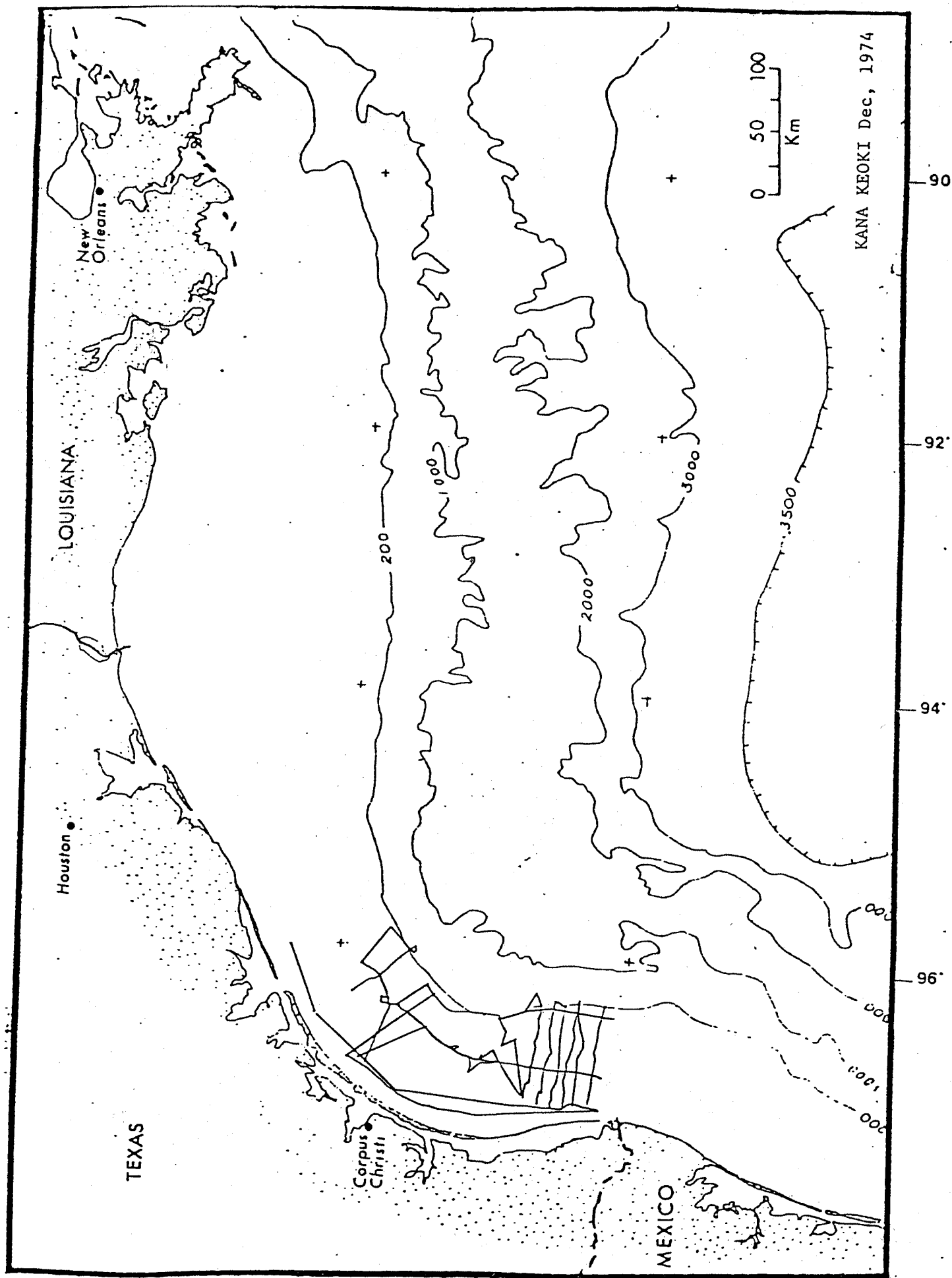


Figure 1--Location of benthic sample stations for geologic studies. • indicates bottom grab; ◉ indicates both pipe core and box core in addition to bottom grab.



KANA KEOKI Dec, 1974